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BTEC

Mark Scheme (Results)

June 2022

Pearson BTEC Nationals
In Applied Science (31617H)
Unit 1: Principles and Applications of Science I - Physics

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Unit 1: Principles and Applications of Science I

General marking guidance

- All learners must receive the same treatment. Examiners must mark the first learner in exactly the same way as they mark the last.
- Marking grids should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the marking grid, not according to their perception of where the grade boundaries may lie.
- All marks on the marking grid should be used appropriately.
- All the marks on the marking grid are designed to be awarded. Examiners should always award full marks if deserved. Examiners should also be prepared to award zero marks, if the learner's response is not rewardable according to the marking grid.
- Where judgement is required, a marking grid will provide the principles by which marks will be awarded.
- When examiners are in doubt regarding the application of the marking grid to a learner's response, a senior examiner should be consulted.

Specific marking guidance

The marking grids have been designed to assess learner work holistically. Rows in the grids identify the assessment focus/outcome being targeted. When using a marking grid, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches the learner's response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer, in response to the assessment focus/outcome and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band, depending on how they have evidenced each of the descriptor bullet points.

BTEC Next Generation Mark Scheme

Question Number	Answer	Additional Guidance	Mark
1 (a)(i)	B 2½		1
1 (a)(ii)	8 (cm)		1
1 (a)(iii)	20 (s)		1
1 (b)	A description including: (water molecule/particles) {vibrate/oscillate}(vertically) (1) at right angles/90°/perpendicular/ normal to {direction of travel of the wave /to the surface of the water} (1) the idea that the molecules do not move in the direction of/with the wave (1)	 accept up and down ignore side to side ignore references to energy/energy transfer stay at the same point/position horizontally /on the spot	2
1 (c)	 substitution (1) 1.5 = 2.5 x λ Rearrangement (1) 1.5 (= λ) 2.5 evaluation (1) 0.6 (m)	answer 0.6 (m) without working gains full marks substitution and rearrangement in either order $\lambda = \frac{v}{f}$ 1.67 or 1.66(recurring) gains 2 marks. 1.6 no mark awarded, rounding incorrect. 1.6 gains 1 mark with correct substitution shown 3.754 or 3.8 without working gains 1 mark, with correct substitution correct gains 2 marks	3
		Total	8 marks

Question Number	Answer	Additional Guidance	Mark
2 (a)	One from spreading/widening/broadening(out) (1) bending/changing direction (1)	Ignore separating/splitting/ scattering/ dispersing	1
2 (b)(i)	P and S	both gases are required for the mark accept S and P in either order	1
2 (b)(ii)	Reasons including (gases P and S) have (spectral) lines/emission spectra/spectra/ patterns /wavelengths (1) and one from (that){match /line up with/align/ are identical to/in the same position/same place} (as those in the atmosphere of the star)(1) (P and S) are the only combination that gives 9 lines (in the atmosphere of the star (1) Q and R have no matching lines (1)	accept dark/bold lines accept lines that do not match award **both** marks for the spectral lines of P and S match up with the spectral lines of the star (2) OR P and S are the only combination of lines that give 9 lines in the same position (2)	2
		Total	4 marks

Question Number	Answer	Additional Guidance	Mark
3 (a)	B		1
3 (b)	substitution (1) $\frac{3.0 \times 10^8}{2.0 \times 10^8} = \frac{\sin 48^\circ}{\sin r}$ rearrangement/ use of sine (1) $\sin r = \frac{\sin 48^\circ \times 2.0 \times (10^8)}{3.0 \times (10^8)}$ OR $\sin 48^\circ = 0.74(31)$ OR $\frac{\sin 48^\circ}{\sin 1.5} = 28.39$ evaluation of sin *r* (1) $\sin r = 0.50$ evaluation of *r* (1) 30°	answer 30° without working gains full marks substitution and rearrangement in either order $\sin r = \frac{\sin i \times c}{v}$ correct rearrangement without use of 'sine' gains a mark $r = \frac{i \times c}{v}$ or $r = \frac{48}{1.5}$ $r = 48 \times \frac{2}{3}$ accept 28.4 accept 0.495 answers rounding to 0.5 in answer line gain three marks sin r given as 1.1 or 2.02 or 0.897 or 8.07 gains 2 marks r=32 gains 2 marks r=72 gains 1 mark accept 29.7° and answers rounding up to 30° $\frac{c}{v} = 1.5/\frac{3}{2}/1\frac{1}{2}$ gains one mark if no other mark awarded	4
		Total	5 marks

Question Number	Answer	Additional Guidance	Mark
4 (a)(i)	A description including: voltage/it (continuously) varies (1) with time (1)	 allow signal allow varies randomly/ goes up and down/ changes /oscillates/fluctuates	2
4 (a)(ii)	Award **one** mark for identification and **one** additional mark for appropriate expansion. identification (1) high sampling rate expansion (1) (so that) digital signals are {nearer to /more like} the {shape/pattern} of the analogue signal Or Improves {quality/accuracy/ precision/clarity} (of signal)	 accept short sampling time allow reverse argument for low sampling rate	2

4 (b)	Award **one** mark for identification and **one** mark for appropriate expansion for each paired response up to a maximum of **two** marks Identification (1) (digital signals) can travel further/longer distance Expansion (1) (they) can be regenerated **OR** Identification (1) less affected by noise/distortion /interference /better quality (1) Expansion (1) (because) only two states/0 and 1/binary/ on and off/noise not regenerated **OR** Identification (1) signals can be (easily) encrypted Expansion (1) gives greater security/more difficult to intercept/ interfere with/hack **OR** Identification (1) can be regenerated by a repeater Expansion (1) noise is not regenerated/distortion removed	Ignore quicker /faster	2
		Total	6 marks

Question Number	Answer	Additional Guidance	Mark
5 (a)	C Wi-Fi can be used to connect multiple devices to the internet.		1

<table>
<tr><th>Question number</th><th>Indicative content</th></tr>
<tr><td>5 (b)</td><td>

Similarities

- Both use electromagnetic/transverse waves.
- Both allow signals to be transmitted over long distances.
- Optical fibre cables and satellites dishes/satellites are both subject to damage.
- Both provide access to internet/broadband.

Differences

Method of transmission

<table>
<tr><th>optical fibres</th><th>satellites</th></tr>
<tr><td>through bundles of (cladded) glass fibres that form a cable</td><td>through the atmosphere/air to a satellite and back to a satellite dish (connected to the home)</td></tr>
<tr><td>pulses of visible light or infrared</td><td>digital signals carried by microwaves or radio waves</td></tr>
<tr><td>uses total internal reflection</td><td>uses line of sight</td></tr>
<tr><td>cables usually underground</td><td>signal above ground</td></tr>
<tr><td>(home) must be near the cable network/does not need line of sight</td><td>(dish) must point directly at the satellite</td></tr>
<tr><td>very little interference, good reliability and quality of signal</td><td>quality of signal affected by weather (rain) and terrain</td></tr>
<tr><td>less delay through cable</td><td>inherent delay due to time of travel to satellite and back noticeable time lag</td></tr>
<tr><td>better security more difficult to hack</td><td>easier to hack</td></tr>
<tr><td>faster broadband speed needed for gaming/live streaming</td><td>slower broadband suitable for browsing and sending emails</td></tr>
<tr><td>travels at 2x 10^8 ms^{-1} in glass</td><td>travels at 3 x 10^8 ms^{-1} in air</td></tr>
</table>

Wave frequency

<table>
<tr><th>optical fibres</th><th>satellites</th></tr>
<tr><td>light or infrared</td><td>microwave, radio waves</td></tr>
<tr><td>{higher/bigger/larger} frequency/{smaller /shorter} wavelength</td><td>{lower/smaller less} frequency/ {longer/larger} wavelength</td></tr>
</table>

</td></tr>
</table>

		high(er) bandwidth, multiplexing	low(er) bandwidth
		can carry more information/data	carries smaller amount of data

Mark scheme (award up to 6 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.

Level	Mark	Descriptor
Level 0	0	No rewardable material.
Level 1	1–2	• Demonstrates adequate knowledge and understanding of scientific facts/concepts to the given context with generalised comments made. • Generic statements may be presented rather than linkages to the context being made so that lines of reasoning are unsupported or partially supported. • The comparison will contain some similarities and differences showing some structure and coherence.
Level 2	3–4	• Demonstrates good knowledge and understanding by selecting and applying some relevant scientific facts/concepts to provide the comparison being presented. • Lines of argument mostly supported through the application of relevant evidence drawn from the context. • Demonstrate an awareness of both similarities and differences leading to a comparison which has a structure which is mostly clear, coherent and logical.
Level 3	5–6	• Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of scientific facts/concepts to provide the comparison being presented. • Line(s) of argument consistently supported throughout by sustained application of relevant evidence drawn from the context. • The comparison shows a logical chain of reasoning which is supported throughout by sustained application of relevant evidence.
		Total = 7 marks

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